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TO L. G. BARNOR

REPORT NO.
KZ 3545V

Date July 11, 1945

Subject: Smoke Tests of Ventilations
in Process Area Buildings.

PLANT RECORDS DEPT.
CENTRAL FILES

Below are given the results of four series of smoke tests made on March 5, March 12, April 19, and May 16, 1945, to determine the air currents set up by existing ventilating equipment in the Process Area and the effect of shutting down certain fans and/or closing certain louvers. H-15 Orange Smoke Grenades were used as the source of smoke.

These tests were made with the knowledge and approval of Captain M. M. Beckwith and the Carbide Operations and Security Departments. Tests were conducted by members of the Safety Department, usually in the presence and with the assistance of operating personnel.

A description of the tests and their results follows:

March 5.

1. Smoke set off in service alley at end of building K-308-2, adjacent to disposal vacuum pump location. Ventilating fans all operating. Roof ventilators and louvers on all floors open.

Smoke drifted up into pipe gallery where it hung for quite a period (10 minutes) and finally dissipated, and into room on west side of alley. Smoke also pulled into withdrawal alley No. 10, whence part of it rose slowly to pipe gallery and balance was pulled into basement and blown back to stage floor and also through ducts to operating floor. The latter cleared in approximately 15-20 minutes.

2. Smoke released in basement adjacent to intake of operating floor fan. Ventilation as above.

Smoke emitted on operating floor in four (4) seconds. No appreciable amount of smoke on other floors of building except a little in pipe gallery that drifted down through coolant pump wells. (Quite a bit of smoke drifted to operating floor of adjacent building).

3. Same as (2).

Results identical.

4. Smoke released in withdrawal alley No. 10, about midway of alley longitudinally, and adjacent to platform of building K-308-2. (There was a partition running lengthwise through middle of withdrawal alley). Transoms in immediate vicinity of source of smoke closed. Other ventilation as in previous tests.

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(level and category)

ADD signature (first reviewer) *John J. [illegible]* 4/20/96
ADD signature (final reviewer) *Thomas W. [illegible]* 5/1/96

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Carbide and Carbon Chemicals
Corporation, Operating Contractor for
the U.S. Atomic Energy Commission.

This document has been approved for release
to the public by: *[Signature]* 5/7/96
Date
Technical Information Officer
Oak Ridge K-25 Site

Smoke was pulled through leaks around closed transoms immediately, very little making its way through transoms left open at a distance of approximately 50 feet in either direction from source of smoke. However, the leakage through closed transoms was insufficient to be picked up immediately by operating floor fans. A little smoke reached the operating floor, presumably through coolant pump wells, but possibly from operating floor fans. About six (6) minutes were required for any smoke to appear on operating floor.

5. Smoke released in same location as in (4). Ventilating conditions were as follows (conditions proscribed for emergency):

- (a) Transoms from withdrawal alley to basement closed.
- (b) All louvered grilles in operating floor closed.
- (c) All louvers in ducts over escape alley closed.
- (d) All roof ventilators open.
- (e) Operating floor fans off.

There was considerable leakage through transoms to basement, but this was picked up by cell fans. Smoke was heavy in pipe gallery but gradually found its way out roof ventilators. Only a little smoke found its way to the operating floor, and this in north west corner.

6. Smoke released in same location as in (4). Ventilation conditions normal as in (1), except operating floor fans off and all transoms closed.

Results did not differ appreciably from those previous test (5). (The source of smoke on operating floor was found to be through door to stairway to cell floor, which was left open. A large fan in an office adjacent to this door may have affected results).

March 12.

7. Smoke released in withdrawal alley 1A, at point adjacent to platform of K-310-3, about midway of length of alley. Ventilating equipment as follows:

- (a) Transoms in vicinity of release closed.
- (b) Doors between cells in 310-2 and 3 open.
- (c) Operating floor fans off.
- (d) Cell fans on with all discharge ducts open.
- (e) Louvers in ducts over escape alley part open and part closed (left as found).
- (f) Louvered grilles on operating floor open.
- (g) Roof ventilators open.
- (h) Doors at head of stairways on operating floor closed.

Smoke pulled into basement to some extent, through poorly fitting transoms. Slight amount of smoke in escape alley of 310-2 and somewhat more in escape alley of 310-3. Considerable smoke in pipe gallery (mostly in 310-3). No smoke on operating floor.

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8. Location same as (7). Ventilation same as (7) except transoms in vicinity of test open.

Great amount of smoke pulled into basement, but all picked up by cell fans immediately below. Slight amount of smoke in escape alley of 310-2 and considerable in escape alley of 310-3. Fairly heavy in pipe gallery. No smoke on operating floor.

9. Smoke released behind B furnace in building K-101. Furnace room ventilator on. Furnace room doors closed.

Space behind furnaces cleared rather rapidly, but area on north side of furnaces cleared very slowly (7-8 minutes). Door on north side opened momentarily and smoke drifted out door. Slight amount drifted from ventilator exhaust through open windows on east side of still room.

10. Smoke released on main floor of still room between E-102 and E-109-B, building K-101. Still room doors closed. Dumping drum pit ventilator on. Tower ventilator on.

Very little smoke came out pit ventilator. Practically no smoke drifted any appreciable distance toward south end of lower floor. Considerable smoke on mezzanine floor. Building cleared in 7-8 minutes.

11. Smoke released in J-609 pump room of building K-601. Pump room, accumulator room and C-603 condenser room doors closed. Condenser room exhaust fan on. Supply fan in east wall of second floor carbon trap room on.

Smoke exhausted from pump room through accumulator room to condenser room and thence to atmosphere quite rapidly. Some smoke picked up by supply fan mentioned above and drawn back into building. No smoke evidenced anywhere in building except as given above.

12. Smoke released in C-603 condenser room of building K-601. Condenser room door closed and exhaust fan on. Supply fan in east wall of second floor carbon trap room on.

No smoke came out under condenser room door. No smoke down through condenser room floor grille. Some picked up by supply fan as in previous test.

13. Smoke released in second floor carbon trap room of building K-601 near stairway to condenser room. Both supply fans on. Doors and windows closed. Windows in third floor carbon trap room open. Roof ventilator on.

Carbon trap rooms cleared rather slowly (7-10 minutes). No smoke in other parts of building.

14. Smoke released in cell room of building K-601, adjacent to west wall just south of door. Cell room doors closed and exhaust fans on. Pipe gallery exhaust fans off.

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Bulk of smoke picked up by adjacent exhaust fan, but some drifted throughout room. No smoke came up stairway to pipe gallery.

15. Smoke released in ammonia compressor area of building K-1101. Roof ventilators closed (not operable). Exhaust fans off.

Smoke drifted over entire section of building. After two or three minutes exhaust fans turned on and building cleared rapidly.

April 19.

16. Smoke released in withdrawal alley 1-A, adjacent to platform of building K-310-3, at a point near foot of stairway to operating floor.

- (a) Adjacent transoms closed.
- (b) Operating floor fans off.
- (c) Doors at top of inside staircases open.
- (d) Pump well doors open.
- (e) All louvers in ducts over escape alley open.
- (f) All floor louvers open.
- (g) All roof ventilators open.

No smoke was visible on operating floor of 310-3. However, a slight odor of it was noticeable. A slight haze appeared on operating floor of 310-2. Nothing came up thru pump wells.

17. As above except doors at top of staircases closed.

Again slight haze was noted in 310-2 operating floor. This was found to be due to material being picked up by operating floor fans in 310-2 basement. (Louvers in escape alley ducts on operating floor of 310-2 closed).

18. As above except operating floor fans off in both 310-3 and 310-2.

Possible trace of smoke above open floor louvers in 310-2.

Note - Altho material was released near 310-3 side of alley the existing air currents seemed to carry most of it toward the east end and north side of alley.

19. Release as above - ventilation as above except all fans in 310-3 and 3 off.

Smoke gradually drifted up through east end of pipe gallery in 310-2, and to an appreciable degree through operating floor louvers in that location.

May 16.

20. Smoke released in 310-3 cold trap room between the two cold traps, toward east side of room. Doors, wall louvers and damper in exhaust duct closed, but fan was on. Basement fans operating.

Smoke drifted throughout room, but none escaped through louvers or around doors.

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21. Same location - no additional release. Wall louvers and damper in exhaust duct opened. Doors remained closed.

At the end of 30 minutes the room was still smoky. It was estimated that another 15 minutes would be required to clear it. No smoke was evident outside room.

22. Smoke released as in (20), with ventilating conditions as in (20). As soon as all smoke was discharged, wall louvers, doors and damper in exhaust duct were opened.

Smoke started to drift out through doorways. All doors were then closed except one, which was left just cracked. No smoke escaped through this opening, but sufficient air currents were set up, due to pressure differential, to aid materially in clearing room atmosphere. Room cleared more rapidly than in test 21.

23. Smoke released in withdrawal alley No. 1, adjacent to open transom beside cold trap room 310-3. All basement fans on. Wall louvers and exhaust fan duct in cold trap room open. Cold trap room doors closed.

Smoke was rapidly drawn into cold trap room through wall louvers.

Note - At conclusion of this test it was noted that the outside of the filter in the door to the carbon trap room was heavily coated with orange particles, indicating that a smoke of smaller particle size would undoubtedly be pulled into carbon trap room.

CONCLUSIONS

1. (Test 1) In the event of a release in the service alley, rooms on the outside (toward inside of U), would be affected, as well as pipe gallery immediately overhead, and building in general, including operating floor. The emergency ventilating conditions established for a release in the withdrawal alley should also be applied in case of a release in the service alley.
2. (Test 2 and 3) In the event of a fire of oil or waste in the basement adjacent to the operating floor fans, the smoke from such fire would be picked up by the operating floor fans and reach the operating floor so quickly (4 seconds) that the immediate shut down of operating floor fans would not keep the operating floor free from smoke.
3. (Tests 4 and 5) The closing of the transoms along the withdrawal alley is ineffective in eliminating contamination of basement atmosphere, but does serve to cut down the magnitude to such an extent that but little contaminant is picked up by operating floor fans.
4. (Test 1) The roof ventilators on the operating floor are not very effective in clearing the operating floor atmosphere rapidly.

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5. (Test 5) Based on the experience of persons conducting the tests, the closing of all floor louvers on operating floor requires sufficient time to partially defeat its purpose. However, the necessity for closing these louvers is questionable, since in three tests (6,7,8) no smoke came through open floor louvers, and in another test (18) there was only a trace from this source.
 6. (Test 5,6,16,17 and 18) The position of the louvers in the ducts over the escape alley has little, if any, effect on contamination of operating floor atmosphere.
 7. (Test 4,16,17,18) Only in one test (4) was there any indication of material drifting up from pipe gallery through coolant pump walls, and this was not definite. The remaining tests of those given above indicated that there is no need for closing pump wall doors in the event of a release of material on the lower floor.
 8. (Test 5,6,16) In the event of a release on the cell floor, need for closing the doors at the top of staircases in withdrawal alley from cell to operating floor appears questionable, except when there is auxiliary ventilating equipment in operation near head of stairways.
 9. (Test 1,4,5,6,7,8,16,17,18) In the event of a release on cell floor the fans supplying air to the operating floor of the building concerned, should be shut off immediately. It is also desirable to shut down the fans supplying air to the operating floor of the building immediately adjacent unless the two fan alleys are separated by a transformer vault (Tests 17 and 18).
 10. (Test 19) In the event of a release of material on the cell floor the cell fans should be left on as they aid in clearing the atmosphere through ventilators over escape alley and withdrawal alley.
 11. (Test 23) A release of material near the end of the withdrawal alley toward the inside of the U, and adjacent to a cold trap room will contaminate the cold trap room atmosphere, if cold trap room ventilating system is in normal operation.
 12. (Test 20) With damper in exhaust duct, wall louvers, and doors closed in the cold trap room, and with basement fans in operation, material released within cold trap room will not escape to the basement.
 13. (Test 21 and 22) With cold trap room doors closed and ventilating equipment in normal operating condition, the removal of contaminant by existing ventilating equipment is very slow (>30 min.). The removal may be helped by cracking one door just enough to set up a current of air. Too much opening allows the contaminant to drift out to the basement area, due to the loss of pressure differential.
 14. (Tests 20,21,22,23) In the event of an extensive release of material in cold trap room, the carbon trap room will probably be contaminated, due apparently to a pressure differential between the carbon trap room and the main cold trap room.
 15. (Test 9) The exhaust fan in the furnace room of building K-101 is not very efficient for clearing the furnace room atmosphere, particularly the north portion of the room.

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16. (Test 9) Material exhausted from the present furnace room ventilator in building K-101 will, under proper atmospheric conditions, be carried back into still room through windows on east side unless latter are kept closed and tightly sealed.
17. (Test 10) An appreciable release of material on the main floor of building K-101 will, even with tower ventilator on, be distributed over mezzanine floor to a considerable extent. However, the building as a whole will be cleared fairly rapidly by existing ventilating equipment.
18. (Test 11) The exhaust fan in C-603 condenser room in building K-601 is quite efficient for clearing the series of rooms for which it was intended, i.e., J-609 pump room, tails accumulator room, and C-605 condenser room.
19. (Test 12) With exhaust ventilation on in C-603 condenser room of building K-601 material released therein is exhausted through ventilating fan and does not settle through floor grille. (However, with a settling period with fan off, as described in Safety Bulletin No. 7, it is apparent that some material will settle through floor grille into tails accumulator room.)
20. (Test 11 and 12) Material exhausted from ventilator fan in east wall of C-603 condenser room of building K-601 will, under certain atmospheric conditions, be carried back through the supply fan in the east wall of the carbon trap room.
21. (Test 13) With all ventilating equipment in operation, material is cleared from carbon trap rooms (2nd and 3rd floor) of building K-601, rather slowly.
22. (Test 14) In the event of a release of material on west side of coil room of building K-601, its spread to other parts of the building can probably be controlled by the use of existing ventilating equipment.
23. (Test 15) The present exhaust system in building K-1101 appears to be sufficient for an effective clearing of building atmosphere. However, the use of the roof ventilators would undoubtedly help.

RECOMMENDATIONS

It is recommended that:

1. Emergency push button shut off switches for each building, controlling the operating floor ventilating fans, be located at strategic points in each building. (See supplemental sheet for details).
2. The transoms in the following locations be sealed closed from the end of the withdrawal alley to a point just beyond the nearest coil room fan:
 - (a) Alleys on east side of U.
West end and north side of alley.
 - (b) Alleys on north end of U.
South end and west side of alley.
 - (c) Alleys on west side of U.
East end and south side of alley.

(This applies only to locations where adjacent cold trap rooms are to be used).


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3. In the event of a release of material in a cold trap room, one door be left just cracked during the period that the atmosphere is being cleared by ventilating equipment. (Care must be taken that door is not opened sufficiently to cause flow of material from cold trap room to basement atmosphere).
 - *4. An additional exhaust fan be placed in the roof of the furnace room in building K-101, and such fan be equipped with a stack extending above tower doorway.
 - *5. The windows on the east side of the still room of building K-101 be sealed closed.
 - *6. The present roof ventilator in the furnace room of building K-101 be equipped with a stack extending above tower doorway.
 - 7. The grille in the floor of C-603 condenser room in building K-601 be removed, the opening closed, and an exhaust fan, equipped with a stack extending above the roof of the building, be installed in the east wall of the tails accumulator room.
 - 8. The present exhaust fan in the east wall of C-603 condenser room in building K-601 be equipped with a stack extending above roof level.
 - + 9. The roof ventilators in building K-1101 be made operative.
- * To be considered if K-101 is operated.
 - Recommended by letter of April 6, 1945 from L. G. Bamer to H.D. Kinsey.
 - + Recommended Jan. 29, 1945 (recommendation from O.H. Helms to M.W. Carnes).

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R. F. Perkins
Technical Section
Safety Department.

RFP:g

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TO: L. G. Bamer

July 11, 1945

Subject: Operating Floor Fans.

The fans supplying air to the operating floor are located in the basement floor of the building and are fed by two (2) circuit breakers on the constant frequency bus.

The method of connection in a typical building is as follows:

The center row of fans #01-02-03-04 and 05 are used for ventilating the operating floor. These fans are electrically connected with adjacent fans supplying air to the cell floor; constant frequency breaker #7A feeds 9 fans and #4A feeds 6 fans. These breakers are remotely controlled from the operating floor and the operation of either breaker would start or stop the respective fan groups. Individual protection for the motors is provided by Trumbull AT35050G, 50 amp. 3 pole, 600 volt circuit breakers; these breakers allow for individual control of the fans manually but cannot be operated remotely.

To control the starting and stopping of the operating floor fans from remote locations on the operating, cell and basement floors it will be necessary to make changes to the existing facilities in one of the following methods:

1. Utilize the spare breaker in the vault for the supply to the operating floor fans - this will require a feeder to be run to the pull boxes at each of the columns at which these fans are located, a pair of wires can then be dropped from the control station for the breaker on the operating floor to the cell floor and basement to provide a trip circuit to take the breaker out of service by operation of a stop button at these locations.
2. Replace the present type Trumbull AT35050G breakers with magnetic starters at each of the operating floor fans; this will require no change in supply feeders. The remote control stations for stopping or starting fans will require a control circuit be run from each of these fan starters to the operating, cell and basement floors. Existing conduit can be used, but will have to be supplemented as field conditions require to obtain connections between fans and floors.

Submitted by: A. F. Becher
A. F. Becher
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Reviewed by: R. F. Perkins
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AFB:

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